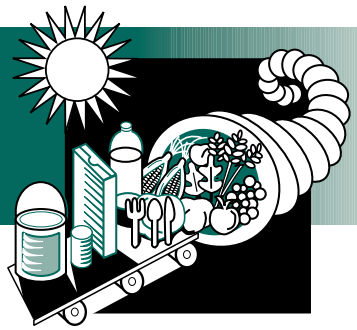
AGRICULTURE

Project Fact Sheet



Near-Infrared Spectroscopy for Individual Seed Screening

Benefits

- Supports reasearch as an enabling technology to rapidly introduce high-yield grains that may replace petroleum-based feedstocks
- Determines chemical composition of individual seeds
- Rapidly and nondestructively screens seeds via parallel processing
- Relies on components that are already commercially available
- May determine chemical differences in seeds with and without genetic modification if sufficient sensitivity is achieved.

Applications

The new seed-screening sorter is particularly applicable to the seed-grain industry. In public and private seed-research programs, this innovative technology is expected to speed production of specialty hybrids with improved or unique traits, especially for the rapidly growing bio-based industrial products market. Grain shippers may be able to use the technology to detect genetically modified seed in export shipments if sufficient sensitivity is achieved.

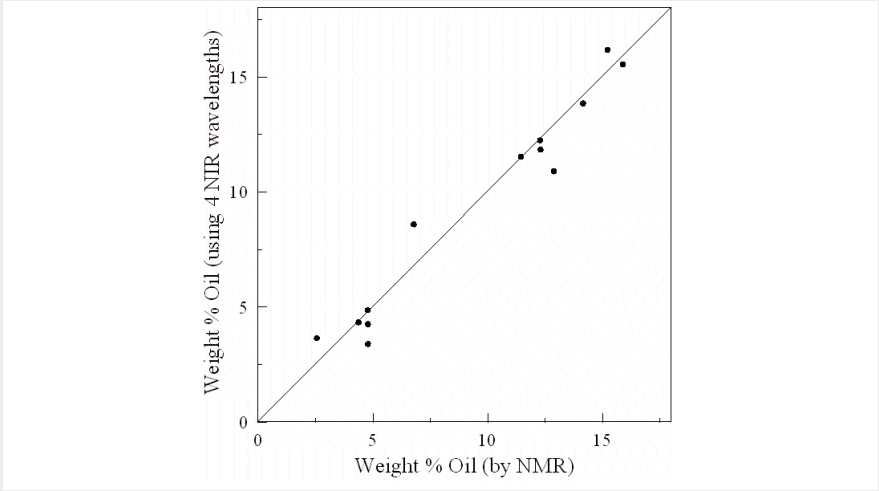
A rapid, nondestructive analysis screens individual seeds for desirable genetic traits

An increasing portion of the agricultural seed industry consists of specialty hybrids carrying specific grain traits. Seed producers would like to quickly screen their seeds' germplasm to select those with the most desirable properties. One of the greatest needs in grain analysis is for a rapid, nondestructive method to screen seeds individually.

Near-infrared spectroscopy, commonly used to chemically analyze grain, has been limited to large samples of seeds. Commercial devices that non-destructively analyze single seeds include several instruments using nonimaging, near-infrared spectroscopy. The problem with these instruments, however, is that two chemically identical seeds will not produce identical spectra because differences in the shapes of the seeds and their internal structures will make them deflect and scatter the spectrometer light beam differently.

A new near-infrared spectroscopy approach combines several technologies to nondestructively and rapidly analyze single seeds exhibiting commercially important properties. The instrument detects only light that has been transmitted through the seed and uses multiple light beams. The result is a capability to view many seeds at one time with much higher seed throughput than that of present commercial technologies.

4-Wavelength Near-Infrared Analysis Compared to NMR



A new technology, being developed by MTEC Photoacoustics, Inc., uses near-infrared spectroscopy to rapidly and nondestructively analyze seeds for their chemical properties.

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ENERGY EFFICIENCY AND RENEWABLE ENERGY • U.S. DEPARTMENT OF ENERGY

Project Description

Goal: Develop, build, and test a prototype capable of sorting corn kernels at the rate of 4 kernels per second based on the percent of oil content.

The new sorter achieves high throughput by using multiplexing technology to marry the well-accepted approach of near-infrared spectroscopy of seeds with the combinatorial-chemistry principle of parallel processing. The instrument combines the chemical resolution of a spectrometer with multisensor detection, thereby providing chemical information simultaneously for each seed. The result is a device capable of analyzing 4 seed transport channels simultaneously, although the approach should be readily expanded to greater numbers of channels.

MTEC Photoacoustics is developing this new technology with the help of a grant funded by the Inventions and Innovation Program in the U.S. Department of Energy's Office of Industrial Technologies.

Progress and Milestones

- Design and assemble a prototype from procured components.
- Develop data-analysis software necessary to convert multiple, single-wavelength, multi-kernel data into enhanced composition of individual kernels.
- Design and build a vacuum-based seed handler.
- Test a prototype sorter with both kernels and ground corn to measure and optimize spectroscopic performance.
- Test a complete prototype sorter on-site and train staff in its use with their own seed stock.

Economics and Commercial Potential

MTEC Photoacoustics has successfully commercialized and sold other high-tech instrumentation similar to the new analyzing sorter in the U.S. and 35 foreign countries. Testing will be performed by the developer's partner, Pioneer Hi-Bred International, Inc. Between MTEC and Pioneer, all facilities required for the project are already available.

The total U.S. market for this near-infrared spectroscopy seed-screening technology is estimated at several million dollars per year; the world market is twice as large. Even if only one-third of customary propagation and selection activities can benefit from this technology, reduction of the substantial research and development costs for seed development could save a single company $12.2 million annually.

The first commercial product, to be introduced 12 months after the project is completed, is expected to capture 20% of its target segment in its first 2 years. Depending on the capability developed and future needs to detect genetically modified grain, shippers may also be a future market for the technology.

Industry of the Future—Agriculture

Agriculture, a target industry for the Industry of the Future initiative, emphasizes partnerships to develop technologies for using plants, crops, and their wastes as starting materials for industrial products. An agriculture industry team has been formed within OIT to facilitate agriculture industry/federal government partnerships. This team will leverage resources available to established OIT teams, such as the chemicals and forest products teams, to strengthen the contributions of the agriculture team and to bring new ideas to the service of the agriculture industry.

OIT Agriculture Industry Team Leader: Mark Paster (202) 586-2821.

The Inventions and Innovation Program works with inventors of energy-related technologies to establish technical performance and conduct early development. Ideas that have significant energy savings impact and market potential are chosen for financial assistance through a competitive solicitation process. Technical guidance and commercialization support are also extended to successful applicants.

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